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I, KIM MARSHALL, MANAGER EXAMINATION SUPPORT AND SALES, hereby certify that the annexed is a true copy of the Provisional specification in connection with Application No. PP 2910 for a patent by GLENBORDEN PTY LTD. and SUNICOVE PTY LTD., filed on 9 April 1998.

PRIORITY DOCUMENT

SUBMITTED OR TRANSMITTED IN COMPLIANCE WITH RULE 17.1(a) OR (b)

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WITNESS my hand this Sixth day of May 1999

KIM MARSHALL
<u>MANAGER EXAMINATION SUPPORT AND SALES</u>

P/00/009 28/5/91
Regulation 3.2

AUSTRALIA

Patents Act 1990

ORIGINAL

PROVISIONAL SPECIFICATION

"FLUID REGULATOR FOR A TRIGGER PUMP"

The invention is described in the following statement:

FLUID REGULATOR FOR A TRIGGER PUMP

FIELD

This invention relates to a trigger pump or hand activated pumping means which is adapted in use to provide a relatively continuous flow.

Other features may be used singularly or in combination to improve operation such as an integral accumulator and fluid regulator which serve to deliver relatively continuous and/or regulated uniform pressure to a nozzle, thus allowing the nozzle to produce relatively continuous high quality spray with intermittent trigger pump action.

CROSS REFERENCE

Reference is made to co-pending applications entitled Fluid Regulator for an Aerosol, 2 Part Regulator and Diaphragm Regulator, filed on the same day by the present applicant, and hereinafter referred to respectively as Aerosol Application, 2 Part Application and Diaphragm Application. The disclosure of these applications is incorporated herein by reference.

BACKGROUND

Trigger pumps currently in use require a person to repetitively and frequently squeeze the trigger to enable product to be dispensed from the nozzle attached to the trigger pump. The product so dispensed is dispensed at a variable pressure so that product is dispensed under a relatively low force initially, building to a relatively high force as the trigger is squeezed mid stroke, and during the period when the trigger is near the end of its stroke, the pressure used to dispense product diminishes relatively rapidly.

Nozzles used in conjunction with trigger pumps are designed with relatively consistent discharge characteristics, such as flow rate and/ or droplet size. Thus the pressure fluctuations experienced due to the operation of the trigger pump cause a great deal of variability in the discharge of the product being dispensed by the trigger pump.

Often the product used in trigger pumps includes chemical additives to enhance the products atomisation under the lower pressures that can be generated during at least part of the trigger pulling process. These additives are undesirable as they may be harmful to the environment, expensive, or take the

place of additional product which could be included in the trigger pump. The size of the particles generated during the atomisation process is dependant on the pressure differential across the outlet nozzle, and trigger pumps can generate a large range of particle sizes in a given squeeze of the trigger. This can lead to inefficient dispersal of the product as the droplet size may not be optimum for its intended purpose. For example, droplets that are too small tend to be influenced by air currents and are difficult to direct, while overly large droplets tend to fall out of the air and may not disperse as widely as desired, or may overly wet an object. Accordingly, it is desirable to be able to control the size of the particles being produced by the trigger pump. Further it is desirable for the nozzle of the trigger pump to produce droplets of a more uniform size.

An object of the present invention is to seek to alleviate the product dispensing limitations of prior art trigger pumps.

SUMMARY OF INVENTION

The present invention provides a trigger pump which includes a means of producing a relatively continuous or more regulated flow output.

The invention stems from the realisation that a trigger pump serves to generate pressure, and that by providing a regulator in fluid communication with the trigger pump, a relatively uniform, regulated and/or prolonged output pressure may be provided, which in turn provides a relatively uniform, regulated and/or prolonged dispersal of product.

In this regard, the invention also provides a trigger pump and including a regulator in fluid communication therewith. Accordingly, the present invention advantageously provides an improved or more controlled droplet size, relatively independent of trigger squeeze pressure and/or frequency.

In a further improvement, the present invention seeks to provide a trigger pump with an accumulator having an output pressure reservoir. The accumulator may be a sleeve accumulator. An output reservoir for pressure and/or product to be dispersed serves to enhance the time a product is dispersed between pump activation(s).

In another form the trigger pump may be adapted to pressurise a container coupled thereto, which includes a regulator. Preferably the regulator

is provided proximate the dispensing nozzle.

Alternatively, the regulator is provided to regulate and/or control the pressure and/or flow rate of fluid delivered to the container. In one form, the regulator is a balanced regulator.

The present invention also relates to a fluid regulator which may be used with a trigger pump. In one form, the present invention includes a fluid regulator comprising a housing having an inlet and an outlet, said housing providing a first chamber open to the inlet, the first chamber being provided with a pair of substantially opposed ports which open to a second chamber, the second chamber having a third port opening to the outlet, an axial support element movable through the pair of ports and received within the first and second chambers, a support element supporting a pair of valve members wherein a valve member is associated with each of the pair of ports, the support element being movable within the first and second chambers to vary the extent of engagement of the pair of valve members with the pair of ports, said support element further supporting a third valve member at one end which is associated with the third port, said support element being biased to an end position at which the pair of ports are open, and the third port is closed, said support element further supporting a pressure surface at the other end which is in the second chamber whereby the force exerted by fluid pressure in the second chamber on the support element counteracts the biasing force applied thereto to rapidly move the support element from its end position to a regulating position where the pair of valves are moved proximate their respective ports to vary the degree of opening of the ports in accordance with the fluid pressure applied at the inlet.

Preferably, when the support element is at its regulating position the third valve member is spaced clear of the third port such that there is substantially no throttling of the fluid flow through the third port.

In one embodiment the biasing force may be adjusted in order to adjust the outlet pressure and/or flow rate of the fluid.

Preferably the support element and the flexible diaphragm are combined into one part. The diaphragm may be a spring diaphragm.

The support member may be supported in its axial movement by fluted bearing guides which allow fluid flow between galleries

In a further form, the present invention provides a method of fluid regulation for a trigger pump including the steps of:

passing fluid from one location to another location;

regulating or controlling the flow of the passing fluid by passing the fluid through a fluid regulator.

In a further form, the present invention provides a method of fluid regulation for a trigger pump including the steps of:

drawing fluid through a first pump chamber and one way valve into a second pump chamber;

pumping fluid from the second chamber into a pressure chamber having a one way valve, wherein the pressure chamber stores the fluid under pressure;

when the stored fluid attains a predetermined pressure, expelling the fluid from the pressure chamber through a regulator, wherein the regulator regulates the fluid flow from the trigger pump.

In the present application the term fluid regulator is defined to mean an apparatus for the regulation and/or control of fluid flow, flow rate and/or pressure of fluid flow.

The invention(s) will be more fully understood in the light of the following description of various embodiments. The description is made with reference to the accompanying drawings of which:

Fig. 1 is a sectional elevation of a first embodiment of the trigger pump of the present invention; and

Fig. 1a is a sectional elevation of a second embodiment of the trigger pump of the present invention;

Fig. 2 is an enlargement of a regulator and nozzle area of the trigger pump shown in figure 1;

Fig. 2a is an enlargement of a regulator and nozzle area of the trigger pump shown in figure 1a;

Fig. 3 is a graph of the relationship between pressure and displacement of a diaphragm of the regulator of the invention;

Fig. 4 is a schematic drawing of an alternative embodiment of an accumulator chamber of the present invention.

Fig. 5, 5a and 5b are graphs of the relationship between outlet pressure and time for the regulator of the present invention.

The present invention will be described below with reference mainly to one embodiment, which is a trigger pump in combination with a balanced fluid regulator and accumulator chamber. Different embodiments of this invention include the combination of:

a trigger pump with a fluid regulator;

a trigger pump with an accumulator chamber;

a trigger pump with a pressurised bottle and a fluid regulator.

Given that the following disclosure describes each of the above noted features, it is considered that in the light of the following description that a skilled person can assemble the various features to form a number of combinations. In particular, a single faced regulator as shown in co-pending application titled 2 Part Regulator , and Diaphragm regulator, filed on the same date by the same applicants, hereby incorporated by cross reference.

The trigger pump 1 as shown in Fig. 1 and Fig. 1a is intended to produce either an intermittent or continuous spray of high quality from a nozzle 2 by sucking fluid (not shown) through a tube 3 immersed in the fluid. The tube 3 having its lower end immersed in the fluid extends into a receiving member 9. The receiving member 9 is accommodated within a body 5 in a first chamber 11. The body 5 includes four chambers inter-connected by ports. The first chamber 11 receives the receiving member 9 and is connected by a port 8 to a second chamber hereafter referred to as pump chamber 7. The receiving member 9 is adapted to form a check valve seat for a ball valve 10, this valve arrangement allows flow in only one direction from an internal chamber 30 of the receiving member 9 to the first chamber 11. The first chamber 11 is also connected to a third chamber 23 by a port 24. The third chamber 23 is connected via a port 25 to a fourth chamber hereafter referred to as accumulator chamber 12. The third chamber 23 serves as housing for a check valve 26 which in this embodiment is integral with a moulded spring 27. The check valve 26 acts against a formed

face of the port 24 to allow flow only in the direction from the first chamber 11 to the third chamber 23. Fluid is also free to flow in either direction between the first chamber 11 and the pump chamber 7. Fluid is free to flow in either direction between the third chamber 23 and the accumulator chamber 12. The check valve 26 is guided within the third chamber 23 by vanes 31 to ensure that it seats correctly against the port 24 and also to allow fluid to pass around it.

The lever 4 is pivoted at pivot point 35 on the body 5 of the trigger pump and acts against a piston 6. The piston 6 is adapted to form two sliding sealing fits in the pump chamber 7 and the pump chamber 205. The pump chamber 7 includes a small port 8 which communicates with the first chamber 11. A spring 29 in the pump chamber 7 is placed between the closed end of the pump chamber 7 and the piston 6 so that the piston is biased in a direction tending to maximise the volume of the pump chamber 7. A conduit 208 from pump chamber 205 allows atmospheric pressure to be pumped back into the bottle or container (as shown in Figure 1a) during the same pumping action for pump chamber 7. Lateral dimples 206 break the second seal on the reverse stroke allowing air into the second chamber. This chamber avoids the container becoming evacuated. Also if the bottle and trigger pump are inverted the second seal stops fluid leaking out.

A piston 202 forms a sliding sealing fit in the accumulator chamber 12 and is biased by a spring 204 which is supported by a cap 28 fixed to the accumulator chamber 12. The spring acts on the piston 202 in a direction tending to reduce the volume of the accumulator chamber 12. The spring 204 may be pre loaded (i.e. it is assembled with sufficient initial compression) so that the piston 202 moves to compress the spring only when the pressure in the chamber 12 is above the regulating pressure of a regulator 34. In the embodiment shown in Fig. 1a, the cap 28 has an aperture 210, which allows any fluid leaking past the piston 202 to return to the bottle.

A nose housing 32 is fitted to an end of the body 5. An extension 33 of the nose housing 32 is received within the open end of the third chamber 23. In the embodiment shown in figure 1 and 2, the spring on the check valve 26 is received within the extension 33. The nose housing 32 contains a nozzle 2 and

the regulator 34 as best seen in Figures 2 and 2a. A number of inter-connected chambers house the fluid regulator and nozzle. The nozzle 2 may be any suitable nozzle, such as those commonly used in aerosol pressure packs, trigger pumps or custom made nozzles.

The regulator 34 is part of the nose housing 32, having an inlet from the tubular extension 33 opening to a chamber 14 accommodated within the nose housing 32. The walls of the chamber 14 are formed with ports 15 and 16. The first port 15 opens to chamber 36 and chamber 14. The second port 16 opens to chamber 18, and chambers 36 and 18 are connected by the port 19 which provides a relatively unrestricted communication between the chamber 18 and chamber 36. The chambers 18 and 36 communicate with the outlet 17 through a port 37.

A spindle like support element 20 is received within the housing 32 such that it is axially slidable through the ports 15 and 16. The support element 20 supports a set of three valve members 21, 22 and 38 which are associated with the first, second and third ports 15, 16 and 37 respectively. The first and second valves are dimensioned such that they are slidably receivable through the respective first and second ports 15 and 16 with a very close tolerance therebetween, however, they do not need to sealingly engage with valve members 21 and 22. The valve member 21 and 22 can be manufactured with a slight interference with ports 15 and 16. The interference will allow the support element 20 to "push fit" home, but not allow the support element to "push out". This approach is used to reduce consequences of manufacturing tolerances.

The end of the support element 20 adjacent the outlet 17 supports the third valve member 38 which is sealingly engagable with a valve seat provided at the third port 37. In Figure 2a, an o-ring sealing arrangement is shown. Below the minimum pressure requirements, the valve member 38 seals against the valve seat to stop the flow of fluid.

In Figure 1, the other end of the support element 20 extends into chamber 18 and is provided with an enlarged disc-like head which is connected to a flexible diaphragm 201. However, any suitable means of attaching the support member 20 to the diaphragm may be used. In another embodiment shown in

Figure 2a, the support element and flexible diaphragm can be combined into one part.

The resilient diaphragm 201 is retained in the housing 32 by a press fit, thread, adhesive, snap tabs or any other suitable means.

In operation, fluid enters the dip tube 3 at its lower end. If the pump is initially filled with air, air will flow in the same way as other fluids and for the purposes of this description only fluid, in general, will be discussed. The spring 29 biases the piston 6 into a rest position which results in the pump chamber 7 being filled with fluid. The lever 4 may be squeezed by finger action (fingers not shown) to move it in a direction towards the pump chamber 7 about its pivot point 35. The lever 4 acts on the piston 6 and reduces the volume of the chamber 7 and chamber 205, forcing fluid to flow into the chamber 11 and air to flow into the bottle to compensate for the fluid removed. The ball check valve 10 prevents fluid flowing back into chamber 30 and is forced to flow through the port 24, unseating the check valve 26 and thus into the third chamber 23. Fluid will then flow into the inlet 14 to the regulator and/or through the port 25 to the accumulator chamber 12. If the pressure within the third chamber 23 is above the opening pressure of the regulator then fluid will flow through the regulator at a substantially constant flow rate. Any excess fluid flow through the port 24 into the third chamber 23 will travel through the port 25 to the accumulator chamber 12, acting against the piston seal 202 to compress the spring 204. If the pressure in the pump chamber 7 falls below the pressure in the accumulator chamber 12, the check valve 26 closes and flow from the first chamber 11 to the third chamber 23 is stopped. If the pressure within the accumulator chamber 12 is above the regulating pressure of the regulator 34, fluid will be forced by the spring 204, piston seal 202 through the port 25, through the third chamber 23 and then to the inlet 14 of the regulator 34. The flow from the accumulator chamber 12 will continue until the piston 202 reaches its limit of travel. The lever 4 may then be activated (squeezed) to increase the pump chamber 7 pressure above the regulating pressure and fluid flow ill continue.

The lever 4 may be depressed to a position limited by stops on the lever 4 or by the coil binding of the spring 29 or by the piston 6 contacting the closed

end of the piston chamber 7. When finger force is released, the piston and lever are returned to their rest positions by the spring 29. The increasing volume of the pump chamber 7 causes a pressure drop in the pump chamber 7 which is transferred through the port 8 to the first chamber 11. The low pressure causes the ball valve to rise off the valve seat on the receiving member 9. Fluid is then caused to flow up the dip tube 3, though the open ball valve 10 into the chamber 11, through the port 8 and into the pump chamber 7. Thus the pump chamber 7 is full and ready to supply fluid for the next pump stroke. Air is also drawn into chamber 205 past the piston 6 whose seal is broken by dimples 206.

The accumulator chamber 12 has a volume sufficient to provide continuous flow to the regulator 34 while the pump piston 6 returns to its rest position. In this manner the flow to the regulator 34 can be kept continuous with the single action piston pump (consisting of 6, 7 and 29) being pumped at a comfortable rate via the lever 4. The volume of fluid held by the accumulator 12 could be several times the volume of fluid contained in the pump chamber 7 to allow for an extended period of continuous spray.

Fig. 4 shows an alternative embodiment of an accumulator chamber 112, which is an elastic sleeve. Chamber 112 may surround the third chamber 23 and fluid may communicate between the chambers through ports 130. The ends 114 of the sleeve 112 are sealingly joined to the third chamber, providing an expanding chamber for the storage of fluid under pressure. It should be understood that the accumulator chamber can take several forms and be placed in several areas of the trigger pump.

When no fluid pressure is applied to the inlet 14 and the pressure is insufficient to overcome the biasing force provided by the diaphragm 201 the biasing force provided by the diaphragm ensures engagement of the third valve member 38 with the third port 37 to close the regulator and prevent any leakage through the nozzle 2. On the application of sufficient fluid pressure to the inlet 14 fluid pressure is admitted to the secondary chamber 18 through both ports 15 and 16 and passageway 19 by free passage through ports 15 and 16 and passageway 19 which in turn exerts a pressure upon the flexible diaphragm 201.

When the applied pressure reaches a predetermined value, the flexible diaphragm 201 deflects and moves the support element 20 downward so that the valve member 38 also moves down and opens the port 37. Fluid then travels through port 37 resulting in pressure acting on the top face of the valve member 38, placing additional load on the flexible diaphragm 201 via the support element 20. This additional load increases the deflection of the diaphragm causing it to move the support element 20 and valve members 22, 21 and 38 downwards, thus rapidly increasing the opening of the valve member 38 in relation to the port 37 and decreasing the opening of the valve members 21 and 22 in relation respectively to the ports 15 and 16. Fluid is then able to travel through the regulator 34 to the outlet 17 and then through (optional) pre-swirl channels 40 to the nozzle orifice 41 located centrally in the nozzle 2. The decreased opening of the ports 15 and 16 throttles the fluid flow through them. The diaphragm 201 is designed to have a pressure versus displacement curve as shown in Fig. 3. It can be seen that an initial pressure A is required for any displacement to occur. Any increase in pressure above pressure A results in a relatively large displacement of the diaphragm. When the valve members 21 and 22 are in close proximity to the ports 15 and 16 the fluid flow is restricted causing a pressure drop. The closer the engagement of the valve member and ports, the greater the pressure drop. This results in pressure changes in the chamber 18 which act against the flexible diaphragm 201. For any inlet pressure above pressure A, the flexible diaphragm 201 assumes an equilibrium position of displacement which results in an outlet pressure (in chamber 18 which is transmitted by free passage through the port 19 to the chamber 36 and then by free passage though the port 37 to the outlet 17) between pressure A and pressure C. Point B on Fig. 3 represents an equilibrium position for a certain inlet pressure D where the pressure drop through the valves 21 and 22 and the respective ports 15 and 16 is such that the pressure in chamber 18 and 36 is pressure B, and the displacement of the support element is displacement B. It can be seen that for a wide range of inlet pressure the outlet pressure remains substantially constant. The inlet pressure exerts no net force on the support element 20 because pressure forces acting on the facing opposed

faces of the valve members 21 and 22 cancel each other. This follows the principal of operation of a balanced inlet pressure regulator. An example of such a regulator is shown in US patent No. 5035260. Further, regulators such as those disclosed in co-pending 2 Part and Diaphragm Applications may also be used.

A specific embodiment of the diaphragm 201 operates in the following manner. In order for the diaphragm 201 to operate, it is desirable to have a large range of movement over a relatively small pressure range as described above. In this way, the support member attached to the diaphragm can move a sufficient distance to open and close the valves 15 and 16 over a relatively narrow range of pressures. Also, it is desirable that the support member 20 not open until a minimum pressure has been achieved, as this provides the lower bound of the pressure regulation. To achieve this, it has been found that a diaphragm with a falling spring rate is desirable, ie more force is required to deflect the diaphragm the first unit of distance than is required to deflect the diaphragm the second unit of distance, as shown in figure 3. Examples of this type of diaphragm are shown in co-pending Diaphragm Application. It is preferable that the regulator should be able to control the upper and lower pressure difference across the nozzle of the trigger pump. There are several ways this can be achieved, including such nozzles as described in US 5035260. Alternatively, other more simple regulators can be used to limit the upper pressure allowed through the nozzle, such as a simple restriction in the nozzle making it difficult to pull the trigger at a sufficient rate to generate higher pressures. A lower pressure regulator may also be employed so that fluid cannot flow through the nozzle until a minimum pressure is achieved.

In order for the pressure to be kept within the limits of any regulation for a suitable time, an accumulator may be included in with the trigger pump. An accumulator may include an expandable chamber whereby fluid can be stored under pressure. This will prolong the time that fluid can travel out of the nozzle within the desired pressure range required for the formation of the appropriate sized droplets. One preferred embodiment of the accumulator includes a chamber having a piston attached to a spring, allowing the storage of

pressurised fluid. Another embodiment includes a resilient sleeve surrounding a chamber, wherein there are passages for fluid communication between the chamber and the sleeve, and the ends of the sleeve are sealingly attached to the chamber.

Although it is preferable to include the regulator with the trigger pump and the accumulator, in some applications where a simple and inexpensive device is required, the trigger pump and accumulator chamber can be used in combination to achieve an improved result in the uniformity of droplet size formation can be achieved over a trigger pump by itself. Also, using the trigger pump and the regulator will also improve the result of the droplet size uniformity over a trigger pump alone, and both these combinations are included within the scope of this invention

Good results have been achieved with the trigger pump used with the accumulator and the regulator. If a diaphragm having these properties is connected to a spring, then a pre-tensioning force is able to be applied to the diaphragm. Such a pre-tensioning force is shown in figure 3. A valve (not shown) may be included upstream or downstream from the nozzle in order to prevent the fluid flowing through the nozzle from drying and possibly clogging the nozzle. Such fluids which will clog nozzles are paint or hairspray. Accordingly, the diaphragm will not move until the force from the pressure on the second chamber equals the force from the spring pre-tension, as seen from where the curves C and D overlap. The diaphragm and spring properties can be combined in the correct proportion such that the pretension force is in the region where there is only a small increase in force required to produce a relatively large change in movement of the diaphragm and accordingly the support member, as shown in figure 3. This allows the support member to open and close over a relatively narrow pressure range, but not open until a desired pressure is attained. It has also been found that by adjusting the pre-tensioning force, the opening pressure can be varied. A spring tension adjusting mechanism may be attached to the diaphragm so that the pressure at which the valve open can be adjusted. The spring and diaphragm may be separate elements as shown in Figures 1 and 2, or combined as shown in Figures 1a and

2a.

In practice the valve members 21 and 22 and the ports 15 and 16 can not be built to match perfectly and thus there will be an inlet pressure above which the valves will not seal perfectly and thus the outlet pressure will rise. By careful control of the accuracy of the respective valve members and ports, this limiting pressure can be kept above the maximum pressure that can be delivered by the piston pump and thus this presents no limitation to the usefulness of the invention. Alternatively a preset valve could be fitted.

In operation the regulator opens when the inlet pressure rises above pressure A and remains open until the inlet pressure drops to approximately pressure A. The inlet pressure is essentially the greater of either the pump pressure or the accumulator pressure at any given time, whilst the outlet pressure is either zero (no flow) or substantially constant.

The rate at which the lever is pulled determines whether the flow from the nozzle is intermittent, within certain flow rate bounds, or continuous within the predetermined flow rate bounds. It should be understood that for a fixed nozzle, a constant pressure will result in a constant flow rate.

From Figs. 5, 5a and 5b, the various outputs can be seen. The outlet pressure of fluid from a trigger pump without a regulator or accumulator. The variation in pressure and intermittent nature of the fluid flow is clearly shown. If the trigger pump is used in conjunction with the regulator, but without the accumulator, the output of the nozzle will be intermittent as shown in fig 5a. If the trigger pump and regulator are used in conjunction with the accumulator, and the rate of pumping the trigger is sufficiently high, then the output will be substantially constant as shown in figure 5b. If the rate of pumping the trigger falls below the critical rate, then the flow from the nozzle will be intermittent, similar to that shown in Fig 5a. In either case, the pressure across the nozzle, and therefore the flow rate of the fluid, is regulated and therefore the particle size is controlled when either a trigger pump with a regulator and/or an accumulator is used.

It should be understood that if a spray nozzle is not used, and the fluid does not form droplets, then the present invention is still useful in restricting the

flow rate of product from the trigger pump.

In a further embodiment, a bottle (not shown) which supplies the fluid may be pressurised by the pump mechanism. The bottle, when used as an accumulator chamber, may be used with or without a fluid regulator. In addition, the fluid regulator may be situated down stream from the pump mechanism, as in the above description, or upstream of the bottle, ensuring that air above a certain pressure is injected into the bottle.

It should be appreciated that the scope of the present invention need not be limited to the particular scope of the embodiment described above.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A fluid regulator comprising a housing having an inlet and an outlet, said housing providing a first chamber open to the inlet, the first chamber being provided with a pair of substantially opposed ports which open to a second chamber, the second chamber having a third port opening to the outlet, an axial support element movable through the pair of ports and received within the first and second chambers, a support element supporting a pair of valve members wherein a valve member is associated with each of the pair of ports, the support element being movable within the first and second chambers to vary the extent of engagement of the pair of valve members with the pair of ports, said support element further supporting a third valve member at one end which is associated with the third port, said support element being biased to an end position at which the pair of ports are open, and the third port is closed, said support element further supporting a pressure surface at the other end which is in the second chamber whereby the force exerted by fluid pressure in the second chamber on the support element counteracts the biasing force applied thereto to rapidly move the support element from its end position to a regulating position where the pair of valves are moved proximate their respective ports to vary the degree of opening of the ports in accordance with the fluid pressure applied at the inlet.

2. A fluid regulator as claimed in claim 1 wherein when the support element is at its regulating position the third valve member is spaced clear of the third port such that there is substantially no throttling of the fluid flow through the third port.

3. A fluid regulator as claimed at claim 1 wherein the biasing force is adapted to be varied.

4. A trigger pump including an accumulator to substantially even out the fluid pressure at the outlet.

5. A trigger pump including an accumulator and a fluid regulator to substantially even out the fluid pressure at the outlet.

6. A trigger pump and regulator in combination.

7. A trigger pump and sleeve accumulator in combination.

8. A trigger pump which is adapted to pressurise a container coupled thereto, and which includes a regulator.

9. A trigger pump as claimed in claim 8, wherein the regulator is provided proximate the dispensing nozzle.

10. A trigger pump as claimed in claim 8, wherein the regulator is provided to control and/or regulate pressure and/or flow rate of fluid delivered to and/or from the container.

11. A fluid regulator as claimed at claim 1 wherein the support element and flexible diaphragm can be combined to be one part.

12. Fluted bearing guides which supports a movable element axially whilst allowing fluid flow between galleries.

13. A fluid regulator as claimed in claim 1 wherein the third valve member is omitted and the function of the third valve is done using the rear face of the valve such that there is substantially no throttling of the fluid flow through the third port.

14. A fluid regulator as claimed in claim 1, wherein an additional spring is inserted internally or externally which in combination with the existing spring diaphragm provides the biasing force and regulating force.

15. The fluid regulator disclosed in any of the preceding claims including a bypass gallery which avoids a condition of no fluid flow.

16. An apparatus and/or method as herein disclosed.

17. A trigger pump including a regulator having a spring diaphragm therein.

18. A regulator as claimed in any one of claims 1 to 3, 5, 6, 8 to 11, 13 to 15 or 17, having a spring diaphragm therein.

19. A method of fluid regulation for a trigger pump including the steps of:

passing fluid from one location to another location;

regulating or controlling the flow of the passing fluid by passing the fluid through a fluid regulator.

20. A method of fluid regulation for a trigger pump including the steps of:

drawing fluid through a first pump chamber and one way valve into a second pump chamber;

pumping fluid from the second chamber into a pressure chamber having a one way valve, wherein the pressure chamber stores the fluid under pressure;

when the stored fluid attains a predetermined pressure, expelling the fluid from the pressure chamber through a regulator, wherein the regulator regulates the fluid flow from the trigger pump.

21. A method of fluid regulation for a trigger pump including the steps of:

drawing fluid through a first pump chamber and one way valve into a second pump chamber;

pumping the fluid form the second chamber into a pressure chamber through a one way valve, wherein pressurised fluid is stored in the chamber, and expelled from the trigger pump.

DATED THIS 9th day of April, 1998

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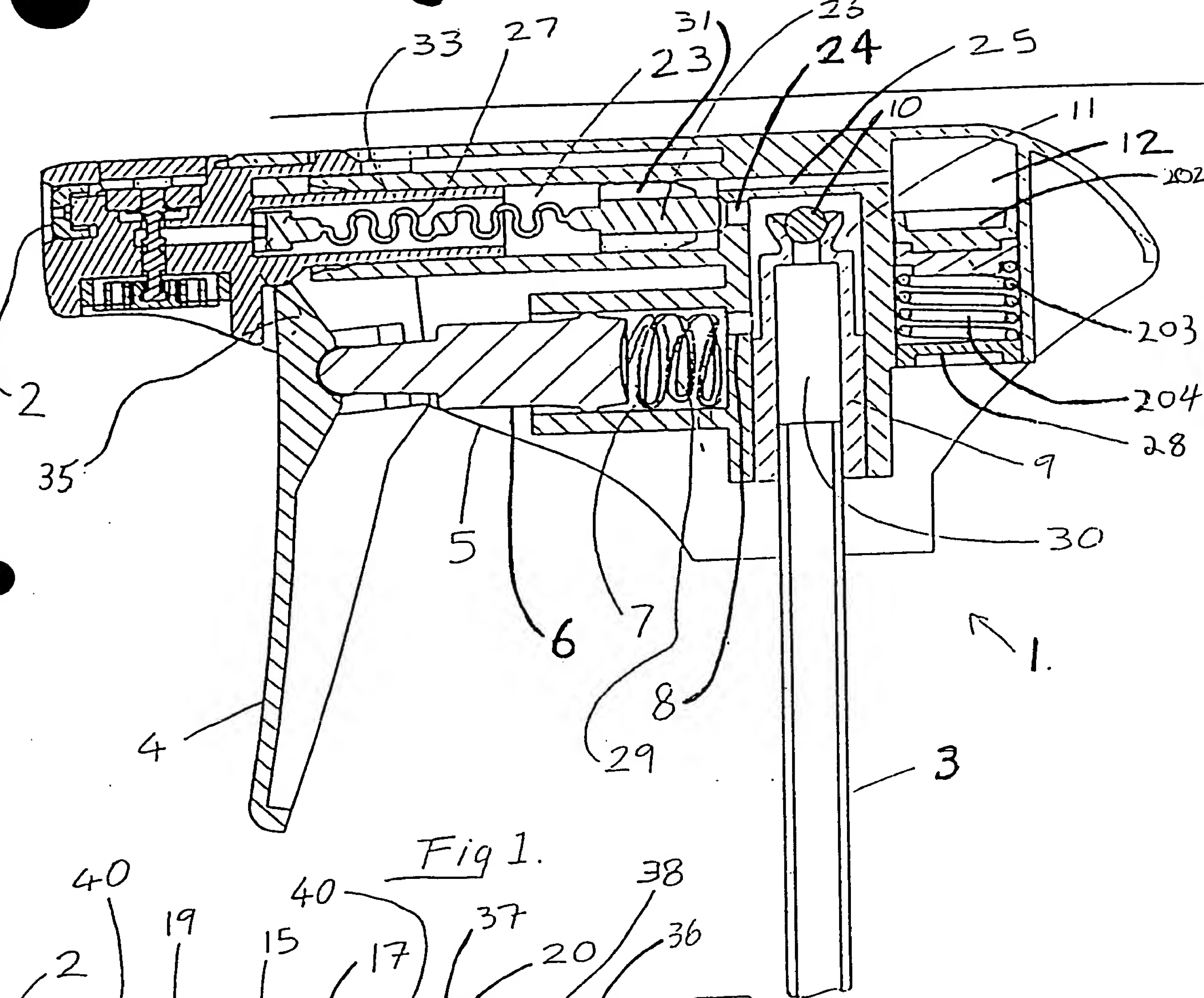

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Fig 1.

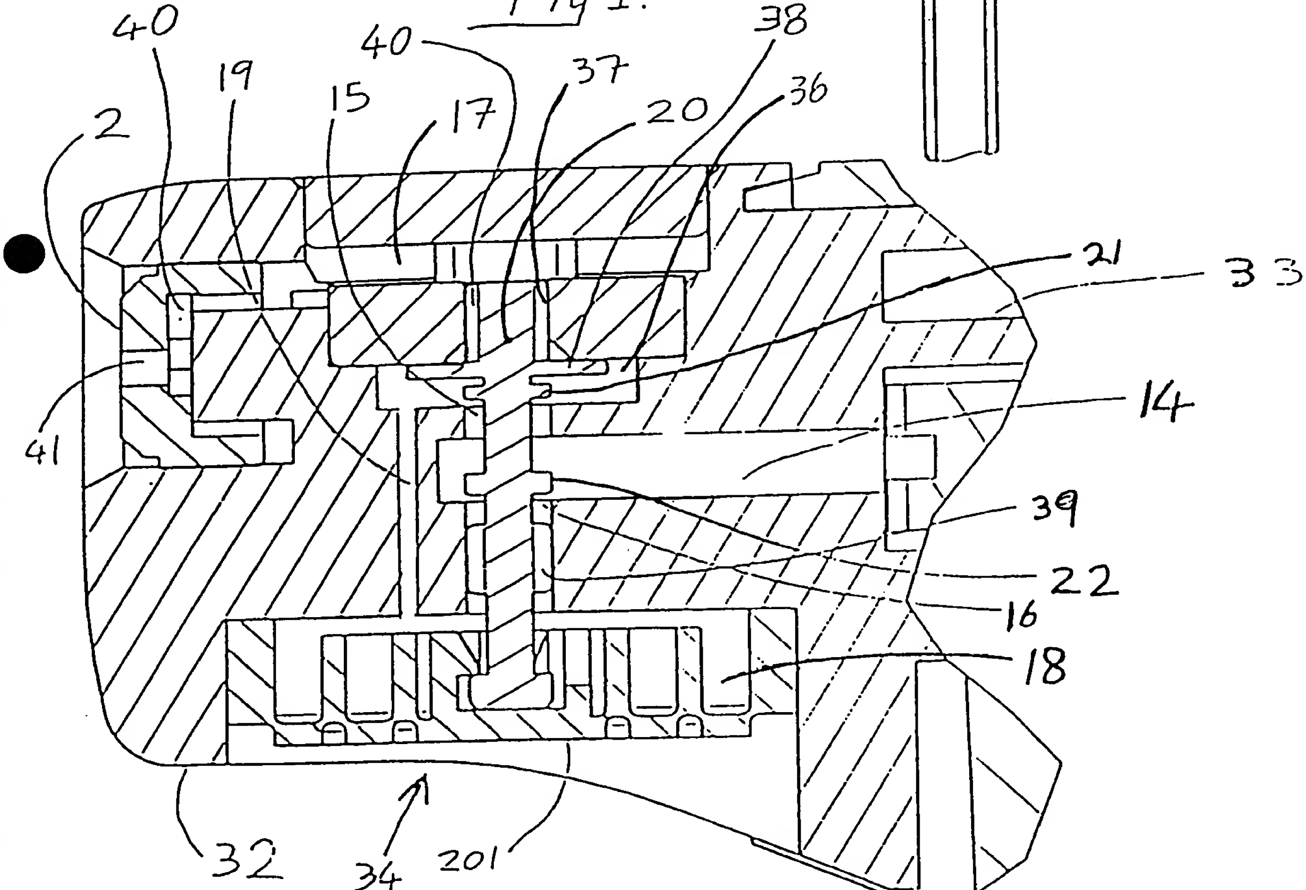

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Fig 2.

Fig 1a

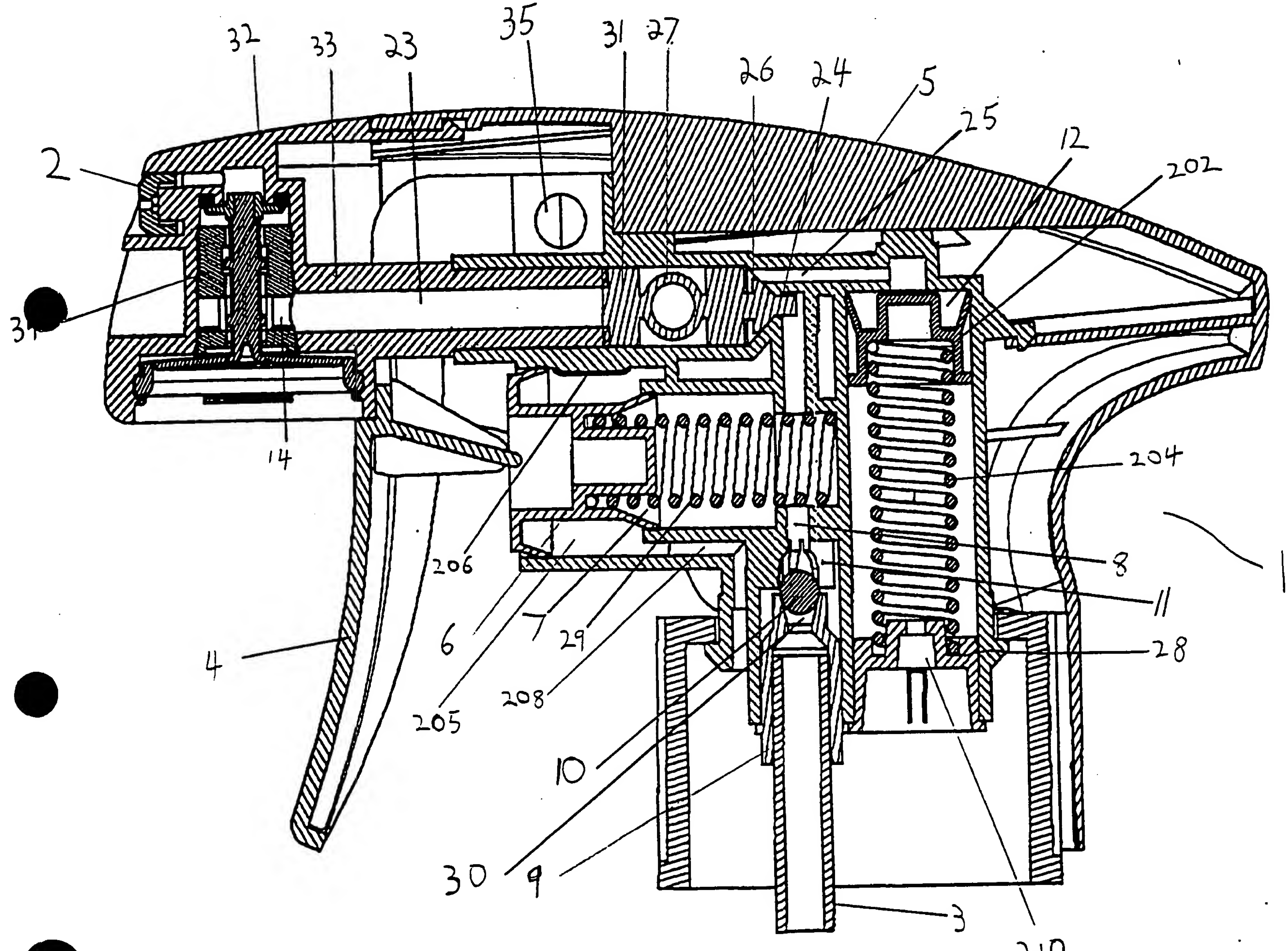

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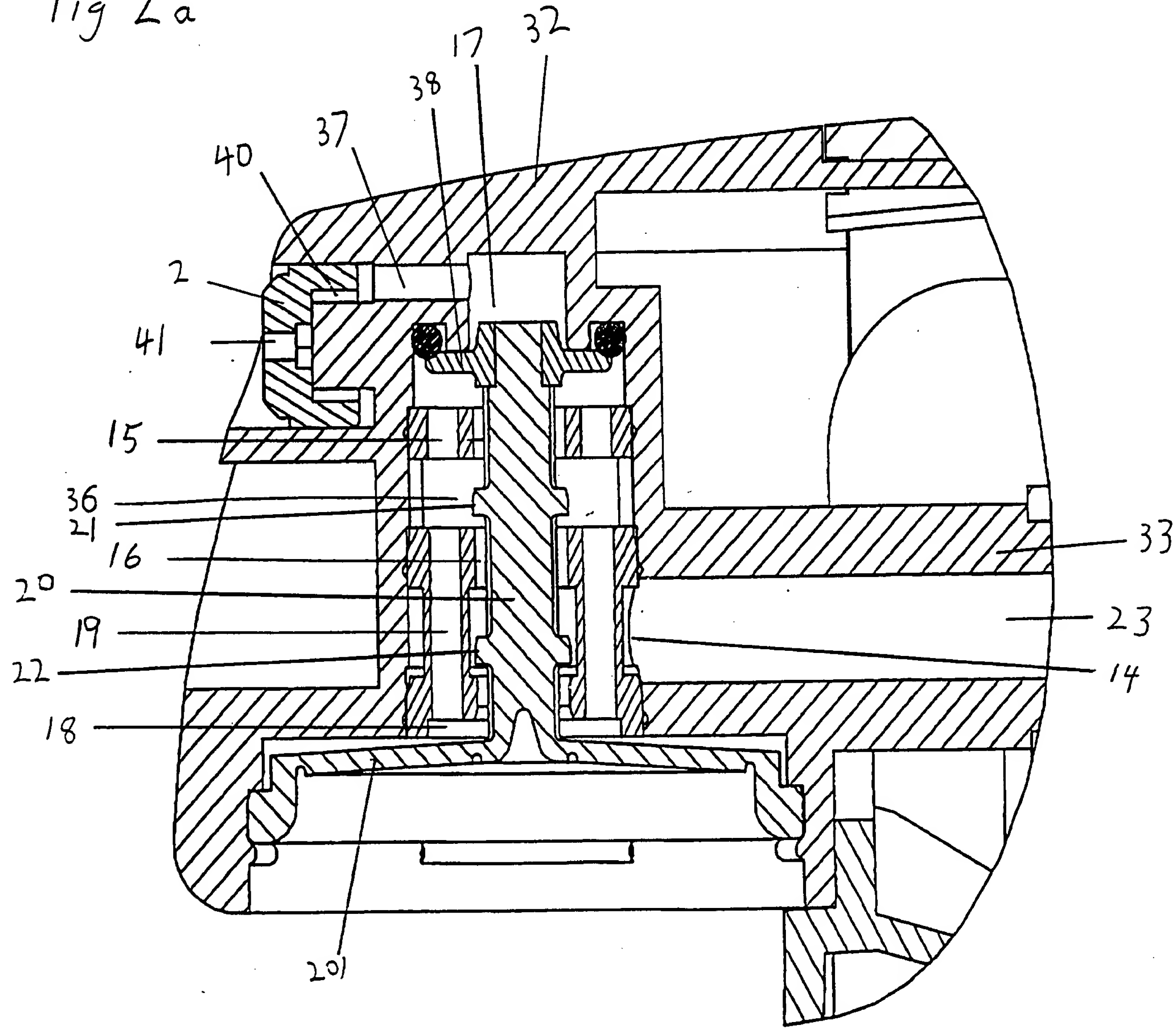
Fig 2a



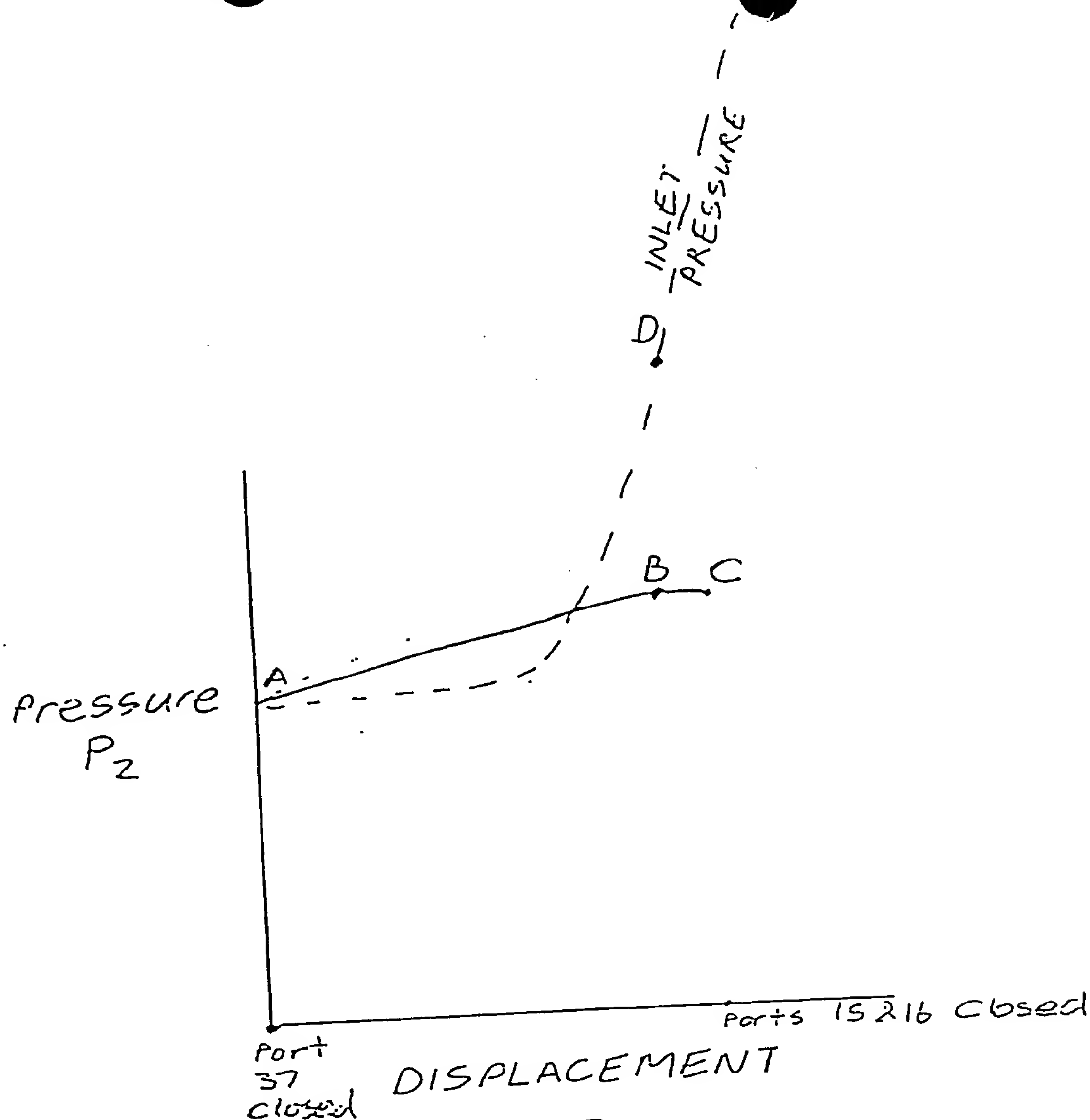
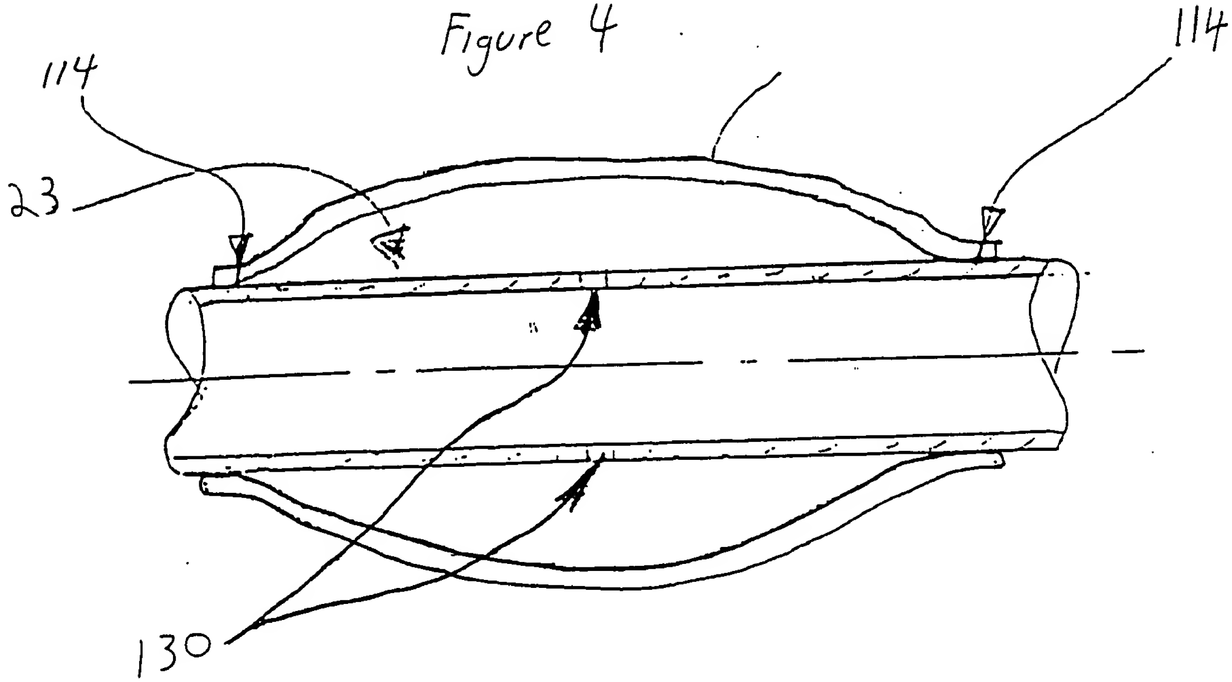

INLET PRESSURE
D
B
C
A
Pressure
P_2
Port 37 closed
Ports 15 & 16 Closed
DISPLACEMENT

Fig 3

Figure 4



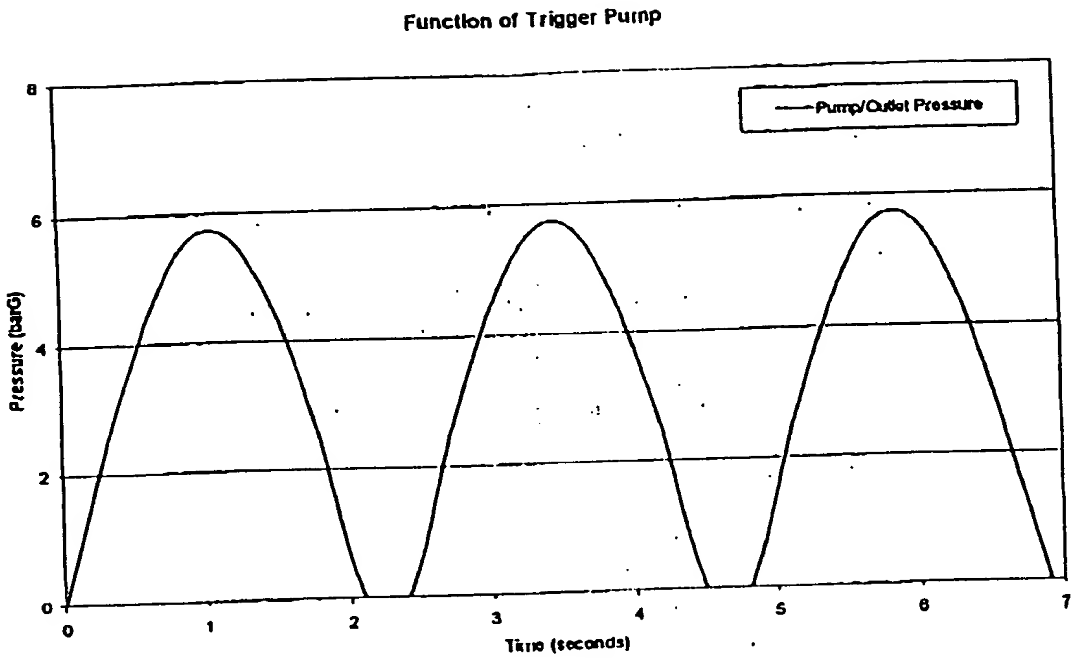


Figure 5

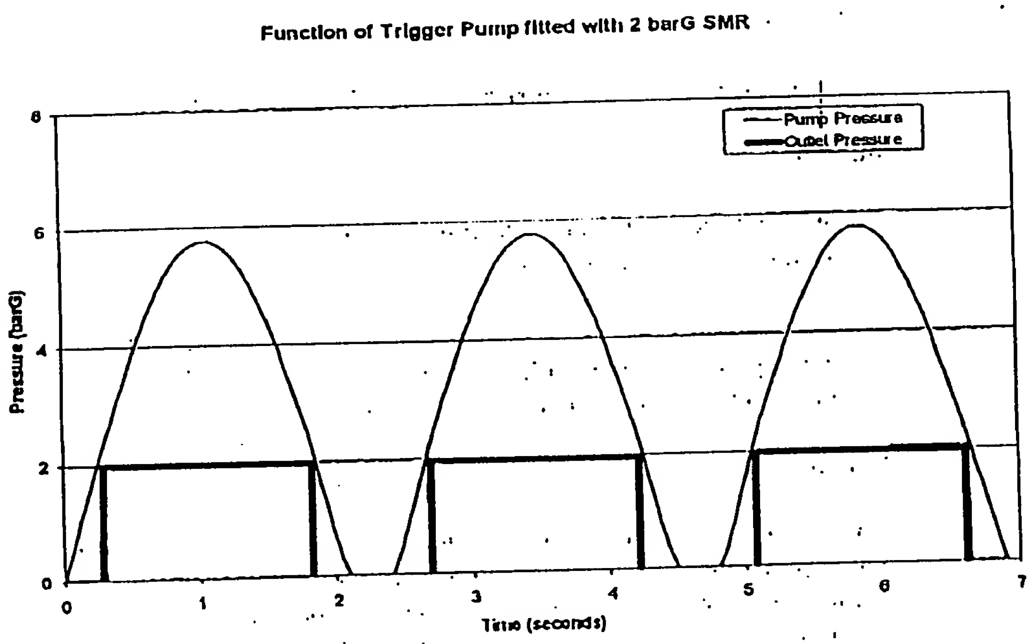


Fig. 5a

Function of Trigger Pump fitted with 2 barG SMR and Accumulator

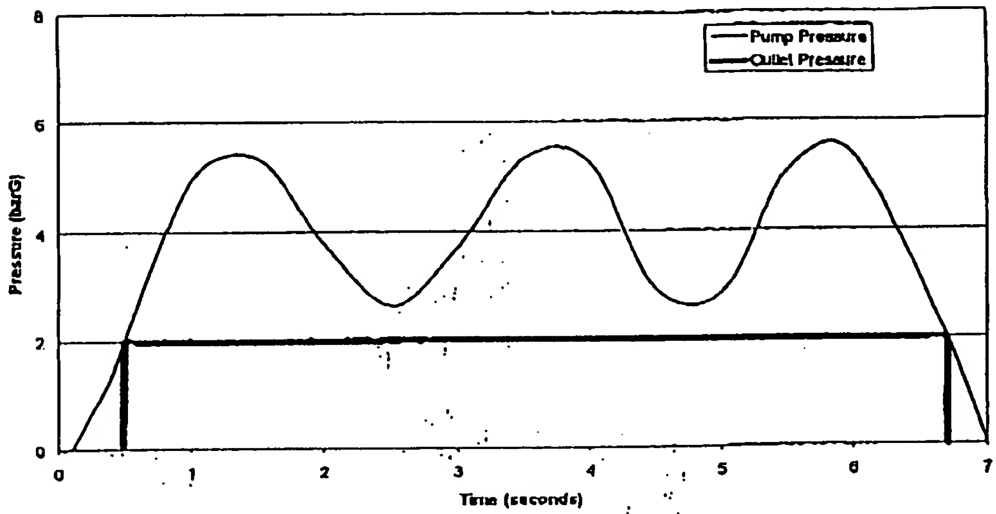


Fig. 5b